

Agency and Liaison Report

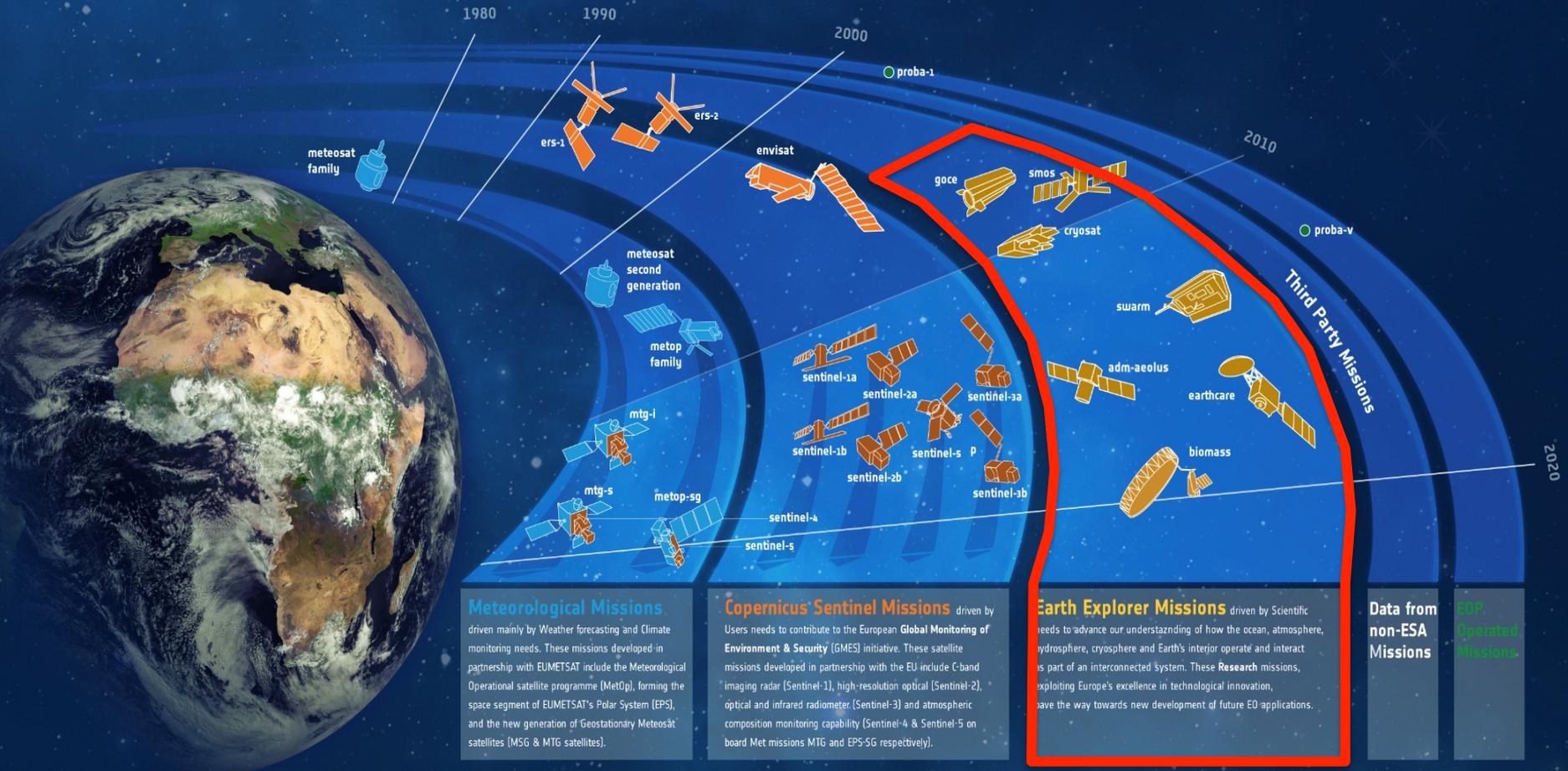
CEOS WGISS Meeting #37

14-18 April, 2014, Cocoa Beach, Florida, USA

Hosted by NASA

M.Albani (European Space Agency)

→ THE ESA EARTH OBSERVATION PROGRAMME



Meteorological Missions

driven mainly by Weather forecasting and Climate monitoring needs. These missions developed in partnership with EUMETSAT include the Meteorological Operational satellite programme (MetOp), forming the space segment of EUMETSAT's Polar System (EPS), and the new generation of Geostationary Meteosat satellites (MSG & MTG satellites).

Copernicus Sentinel Missions

driven by Users needs to contribute to the European **Global Monitoring of Environment & Security** (GMES) initiative. These satellite missions developed in partnership with the EU include C-band imaging radar (Sentinel-1), high-resolution optical (Sentinel-2), optical and infrared radiometer (Sentinel-3) and atmospheric composition monitoring capability (Sentinel-4 & Sentinel-5 on board Met missions MTG and EPS-SG respectively).

Earth Explorer Missions

driven by Scientific needs to advance our understanding of how the ocean, atmosphere, hydrosphere, cryosphere and Earth's interior operate and interact as part of an interconnected System. These **Research** missions, exploiting Europe's excellence in technological innovation, pave the way towards new development of future EO applications.

Data from non-ESA Missions
ESA Co-funded Missions

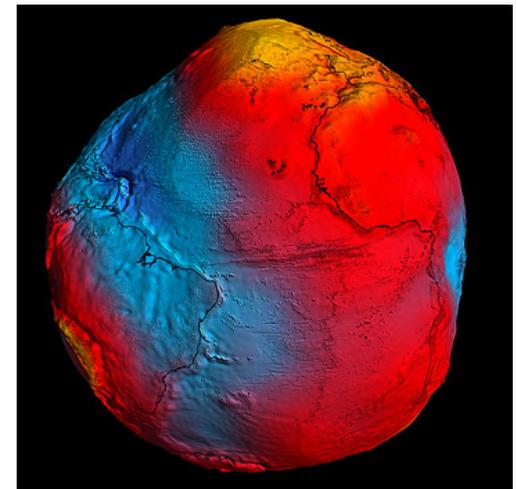
GOCE (2009 - 2013)

- **Status** *Re-entered atmosphere the 11th Nov 2013*
- **Objectives** *Earth gravity field*
- **Instruments** *Electrostatic gravity gradiometer, satellite-to-satellite tracking instrument, laser retro-reflector*
- **Users** *Hundreds of scientists*
- **Facilities** *Stations in Kiruna, Svalbard; Archives & Processing at ESRIN (L1b) and distributed over Europe (L2)*
- **Data volume** *~1 TB of products by end of mission*

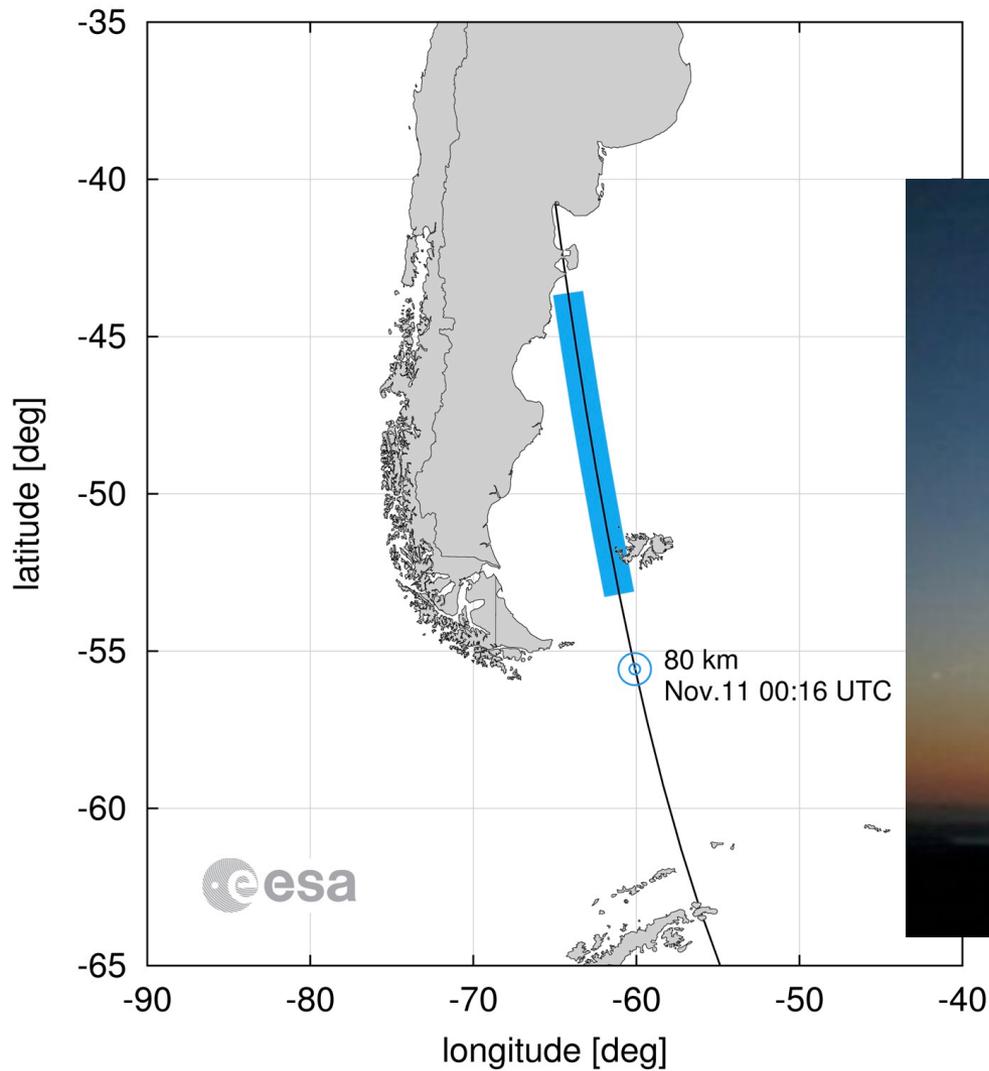


5th Release of gravity field products (L2 gravity field and geoid products) being processed: will be ready during summer 2014

5th GOCE User Workshop will be held from 25 to 28 November 2014 at UNESCO, Paris



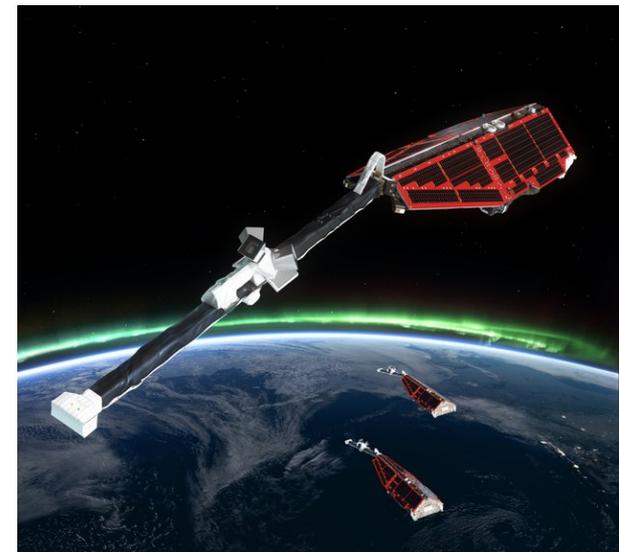
GOCE RE-ENTRY



Swarm (2013 -)

- **Status** *Successfully launched on the 22nd of November 2013*
- **Lifetime** *4 years*
- **Objectives** *Earth magnetic field and near-Earth environment*
- **Satellites** *3 identical satellites in low polar orbits, injected at 490 km, 87.55° inclination*
- **Orbits** *Swarm A & C side-by-side on a 462 km orbit at 87.35° inclination. Swarm B on a 510 km orbit at 87.75° inclination*
- **Instruments** *Vector field magnetometer, advanced scalar magnetometer, electric field instrument, accelerometer, GPS receiver, Laser Retro-reflector*
- **Users** *Magnetic field community, aeronomy, ionosphere and magnetosphere*
- **Facilities** *Kiruna, Farnborough, Level 2 processing by science consortium as part of PDGS*
- **Data volume** *Modest*

LAUNCHED



SWARM LAUNCH & COMMISSIONING

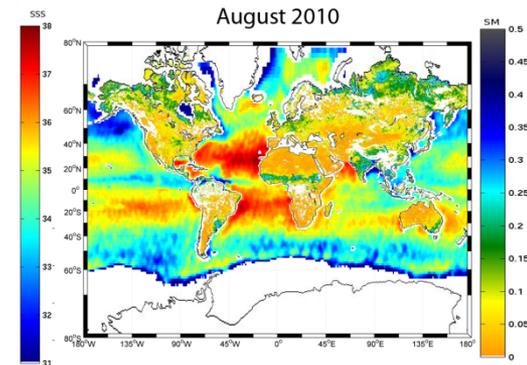


- Launched with ROCKOT on 22nd November 2013 from Plesetsk.
- IOCR successfully held in Mar14; Phase E1 commissioning completed.
- All 3 satellites and PDGS working nominally. Swarm data have been routinely processed and distributed to "special users".
- Swarm A, B and C already in their final orbit altitude.
- Hand-Over from Phase E1 to Phase E2 (Operational Phase) in mid April.
- 3rd Swarm Science Meeting in Copenhagen on 19-20 June.



SMOS (2009 -)

- **Status** *Operational since May 2010*
- **Objectives** *Soil moisture and Ocean Salinity*
- **Instruments** *Passive microwave (L-band)*
- **Users** *Hundreds of scientists (hydrologists, oceanographers, meteorologists etc)*
- **Facilities** *Stations in ESAC Villafranca and Svalbard, Facilities in Kiruna, Satellite ops in CNES Toulouse*
- **Data volume** *~10 GB per day*

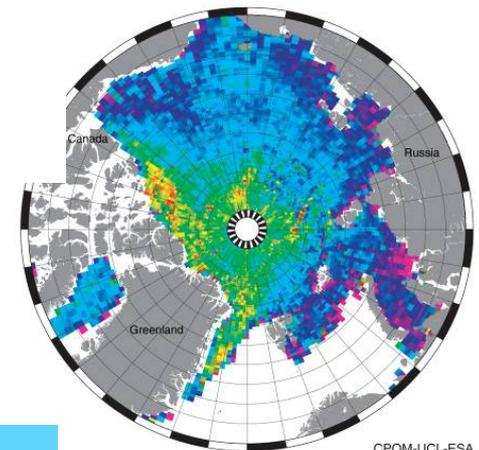


Cryosat-2 (2010 -)

- **Status** *Operational since October 2010*
- **Objectives** *Thickness of sea and land ice*
- **Instruments** *SIRAL radar altimeter, DORIS*
- **Users** *> 300; ~200 institutions worldwide*
- **Facilities** *Kiruna, CNES, ESRIN*
- **Data volume** *~50 GB per day*



Sea ice thickness in the Arctic ocean
(January/February 2011)



Both operating well, mission extension being planned.
Continuous evolution of products and interfaces,
reprocessing campaigns.

ADM - Aeolus

- **Status** *Launch end 2015*
- **Objectives** *Wind Profiles*
- **Instruments** *Lidar*
- **Users** *Met. Offices and scientists,*
- **Facilities** *Stations in Svalbard & Tromsø, Facilities at DLR & ECMWF*
- **Data volume** *5 TB over the entire mission*



EarthCARE

- **Status** *Launch end 2016*
- **Objectives** *quantifying aerosol-cloud-radiation interactions so as to allow their inclusion in climate and numerical weather forecasting models*
- **Instruments** *Backscatter Lidar (ATLID, Cloud Profiling Radar (CPR) provided by JAXA, Multi-Spectral Imager (MSI), Broad-Band Radiometer (BBR)*
- **Users** *Meteorology - Climatology*
- **Facilities** *FOS – ESA PDGS – JAXA PDGS*
- **Data volume** *Level 1: 100 GB/day*

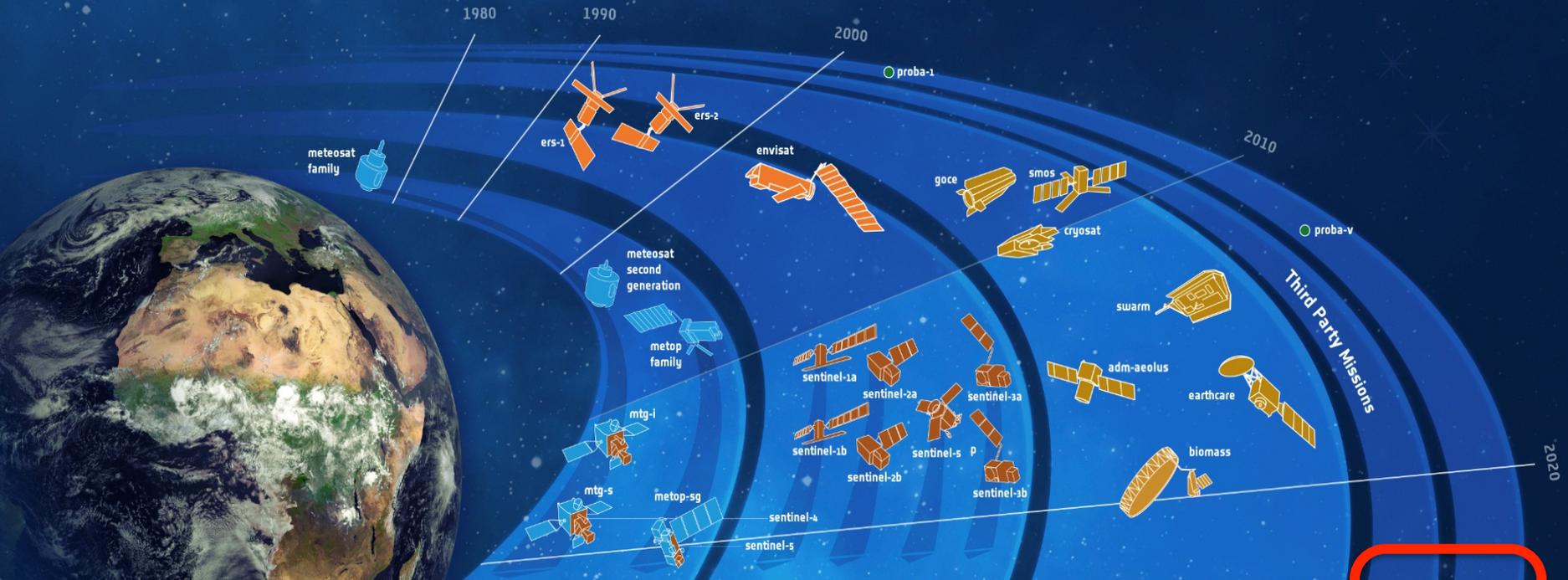


BIOMASS

- **Status** *Launch in 2020*
- **Objectives** *Understand Earth's carbon cycle*
- **Instruments** *P-Band Radar*

Development ongoing

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Earth Explorer Missions

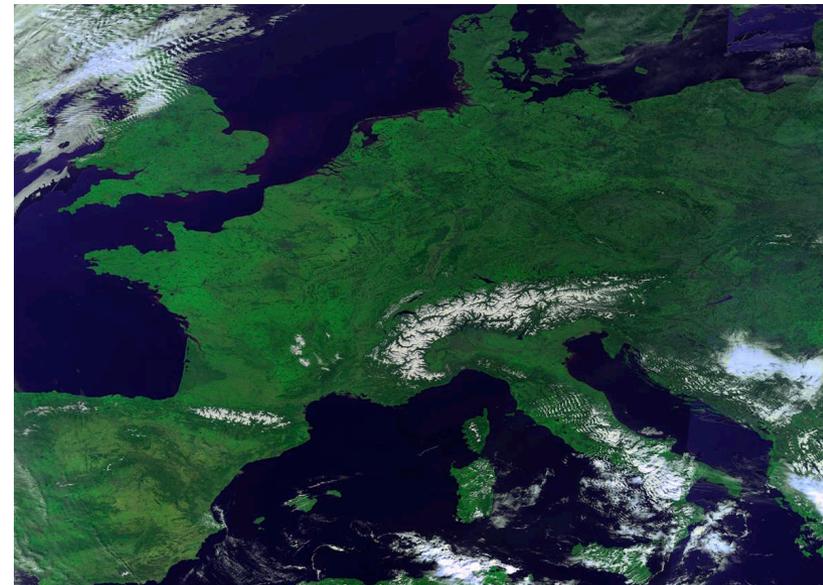
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Data from non-ESA Missions	ESA Copernicus Missions
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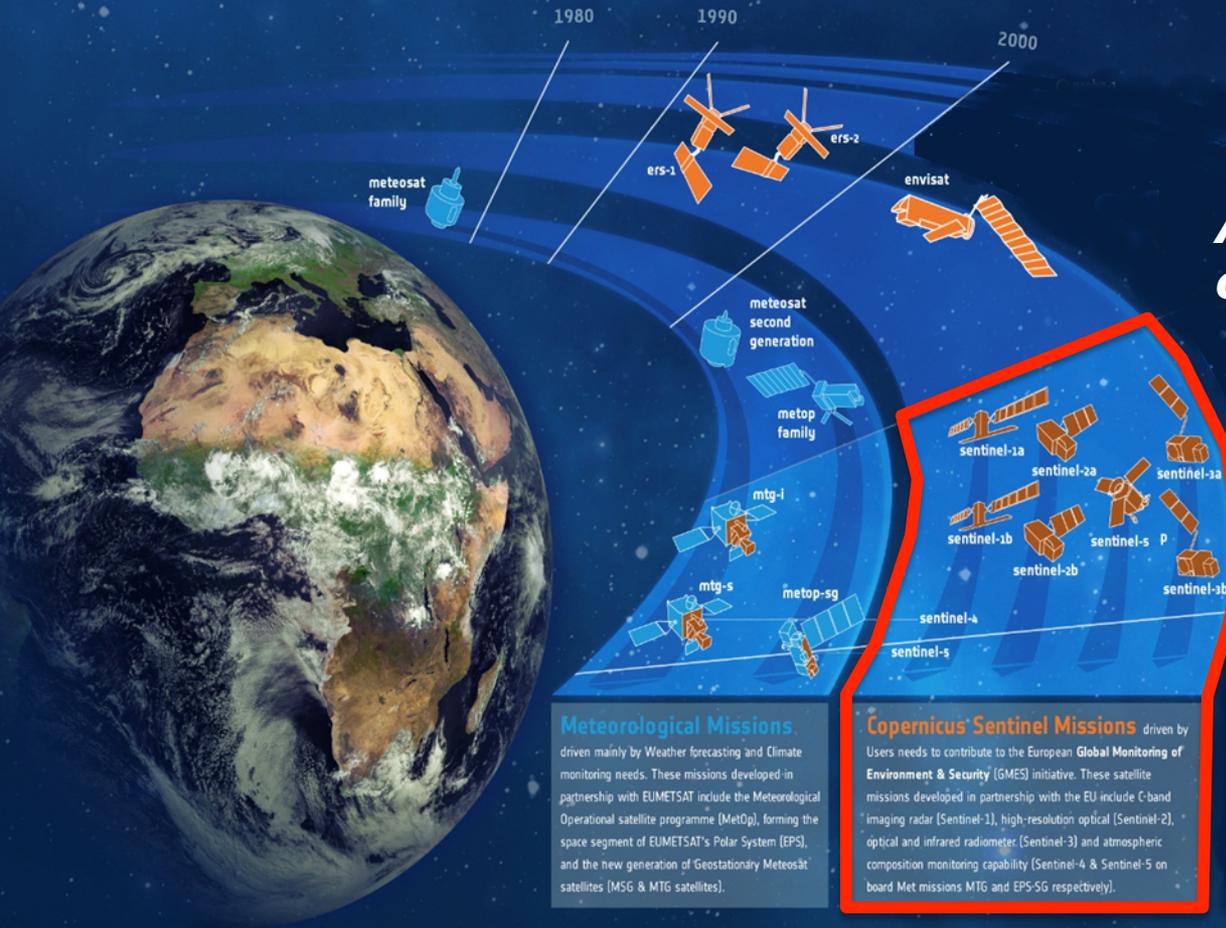
Proba-V



- Built by ESA D/TEC as a technology mission, now part of the EOP Earthwatch programme.
- Launched in Kourou with a VEGA rocket on 7 May 2013
- IOCR successfully completed and mission handover to D/EOP completed in December 2013; Phase E2 started.
- Vegetation Instrument (same as Spot-4/5)
- Products:
 - *1Km resolution products under ESA management (full and open access, free of charge).*
 - *300 meters resolution products property of BELSPO and distributed by Vito (commercial distribution).*



→ THE ESA EARTH OBSERVATION PROGRAMME



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Copernicus' Sentinel Missions driven by Users needs to contribute to the European **Global Monitoring of Environment & Security** (GMES) initiative. These satellite missions developed in partnership with the EU include C-band imaging radar (Sentinel-1), high-resolution optical (Sentinel-2), optical and infrared radiometer (Sentinel-3) and atmospheric composition monitoring capability (Sentinel-4 & Sentinel-5 on board Met missions MTG and EPS-SG respectively).

A New Generation of Data Sources

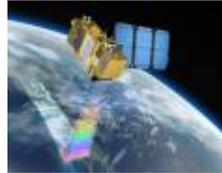
- ✓ Copernicus is a European space flagship programme led by the European Union
- ✓ ESA coordinates the space component
- ✓ Copernicus provides the necessary data for operational monitoring of the environment and for civil security

Copernicus dedicated missions



Sentinel-1 (A/B) – SAR imaging

All weather, day/night applications, interferometry



Sentinel-2 (A/B) – Multi-spectral imaging

Land applications: urban, forest, agriculture,...
Continuity of Landsat, SPOT



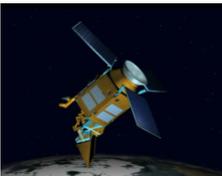
Sentinel-3 (A/B) – Ocean and global land monitoring

Wide-swath ocean color, vegetation, sea/land
surface temperature, altimetry



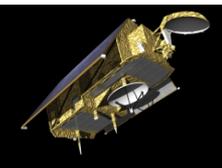
Sentinel-4 (A/B) – Geostationary atmospheric

Atmospheric composition monitoring, trans-
boundary pollution



Sentinel-5 precursor/ Sentinel-5 (A/B) – Low-orbit atmospheric

Atmospheric composition monitoring



Jason-CS (A/B) – Low inclination Altimetry

Sea-level, wave height and marine wind speed

**S-1A LAUNCHED
3RD APRIL 2014**

VIDEO AT

[http://www.esa.int/
spaceinvideos/Videos/2014/04/
Sentinel-1A_rides_into_space_o
n_a_Soyuz](http://www.esa.int/spaceinvideos/Videos/2014/04/Sentinel-1A_rides_into_space_on_a_Soyuz)

VIDEO AT

[http://www.esa.int/spaceinvideos/
Videos/2014/04/
Separation_in_space](http://www.esa.int/spaceinvideos/Videos/2014/04/Separation_in_space)

Solar Wings and SAR antenna opening sequence



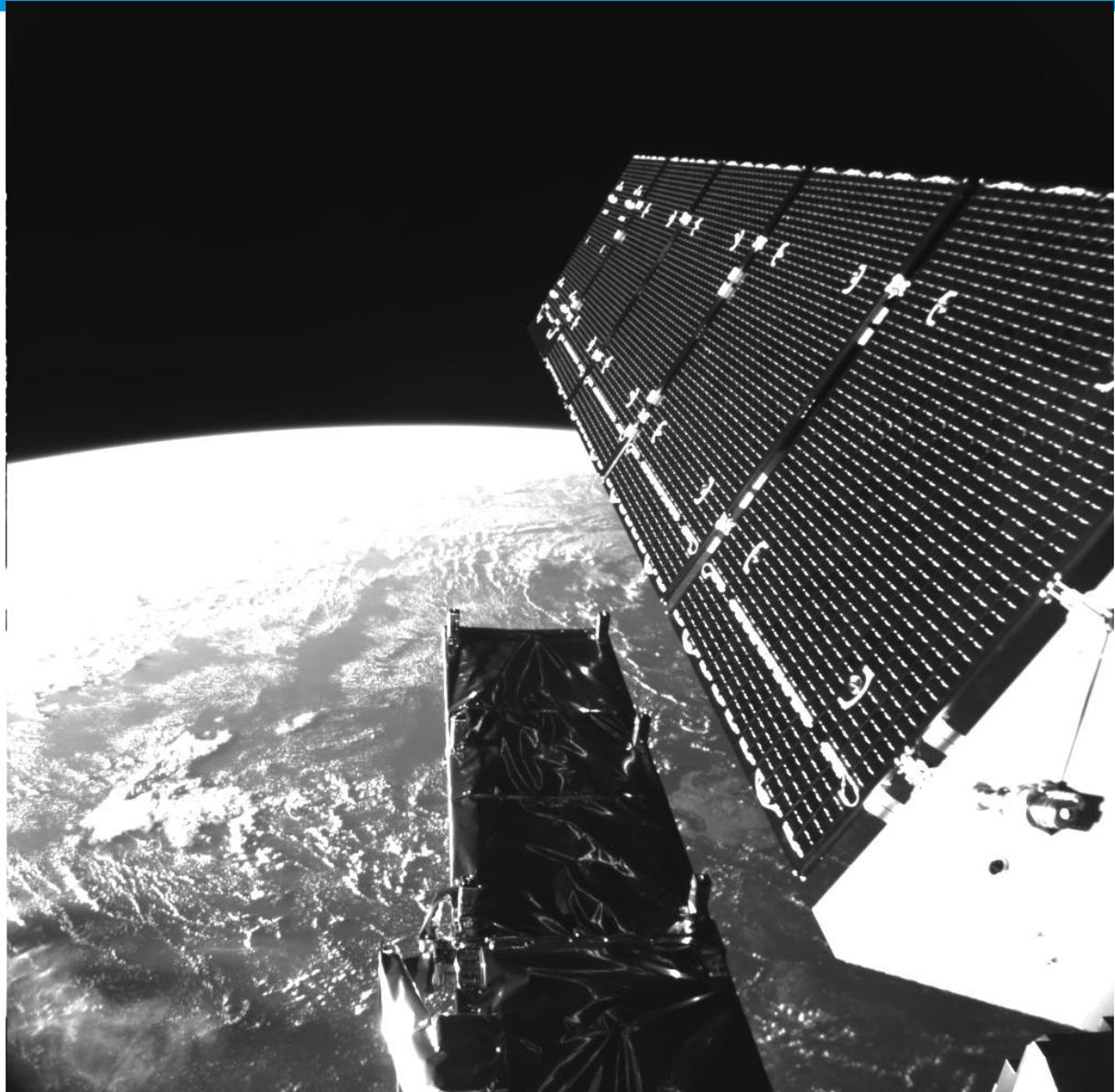
VIDEO AT

http://www.esa.int/spaceinvideos/Videos/2014/02/Sentinel-1_unfolds

Sentinel-1A Selfie



This picture was acquired by one of its onboard cameras. Viewed looking down one of the deployed solar wings with the radar open below - with Earth as the backdrop.



Launch and Early Orbit Phase (LEOP) successfully performed according to the planned timeline and declared closed on 6 April

- Deployments of the solar panels and of the SAR antenna
- Achievement of Satellite Nominal Mode and AOCS Nominal Pointing Mode
- Switch ON and initial checks of the spacecraft sub-systems
- First on-board telemetry and navigation data in band-X was received at the Matera ground station on 6 April, early morning
- First SAR instrument data acquisition was performed on 6 April (3 min wave mode). The related measurement was successfully processed at UK-PAC.

Commissioning started on 7 April for three months (very dense).

- Start of orbit manoeuvre sequence to acquire the target reference orbit
- Calibration, etc...

Sentinel-1A Collision Avoidance Manoeuvre

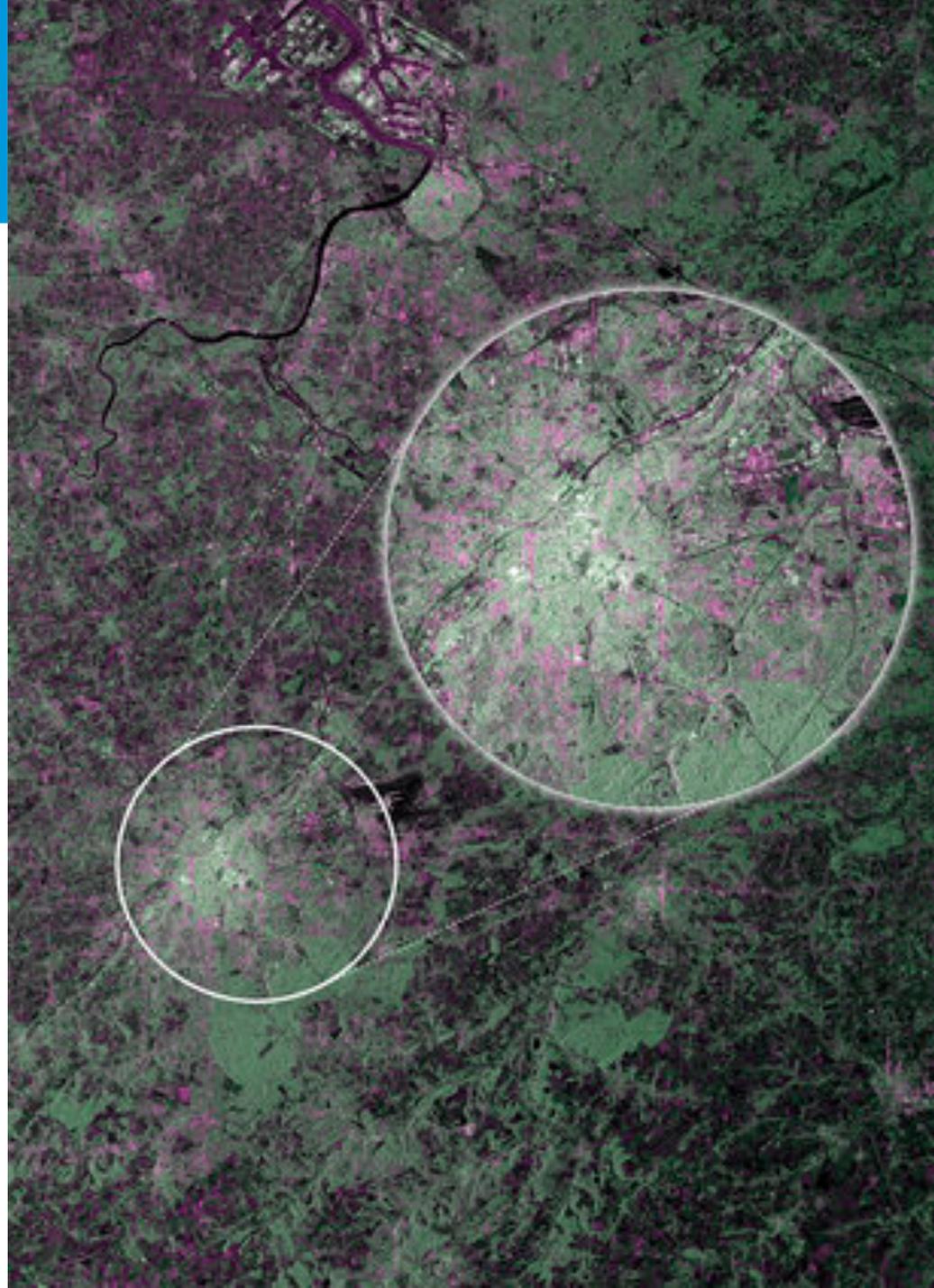
A long day



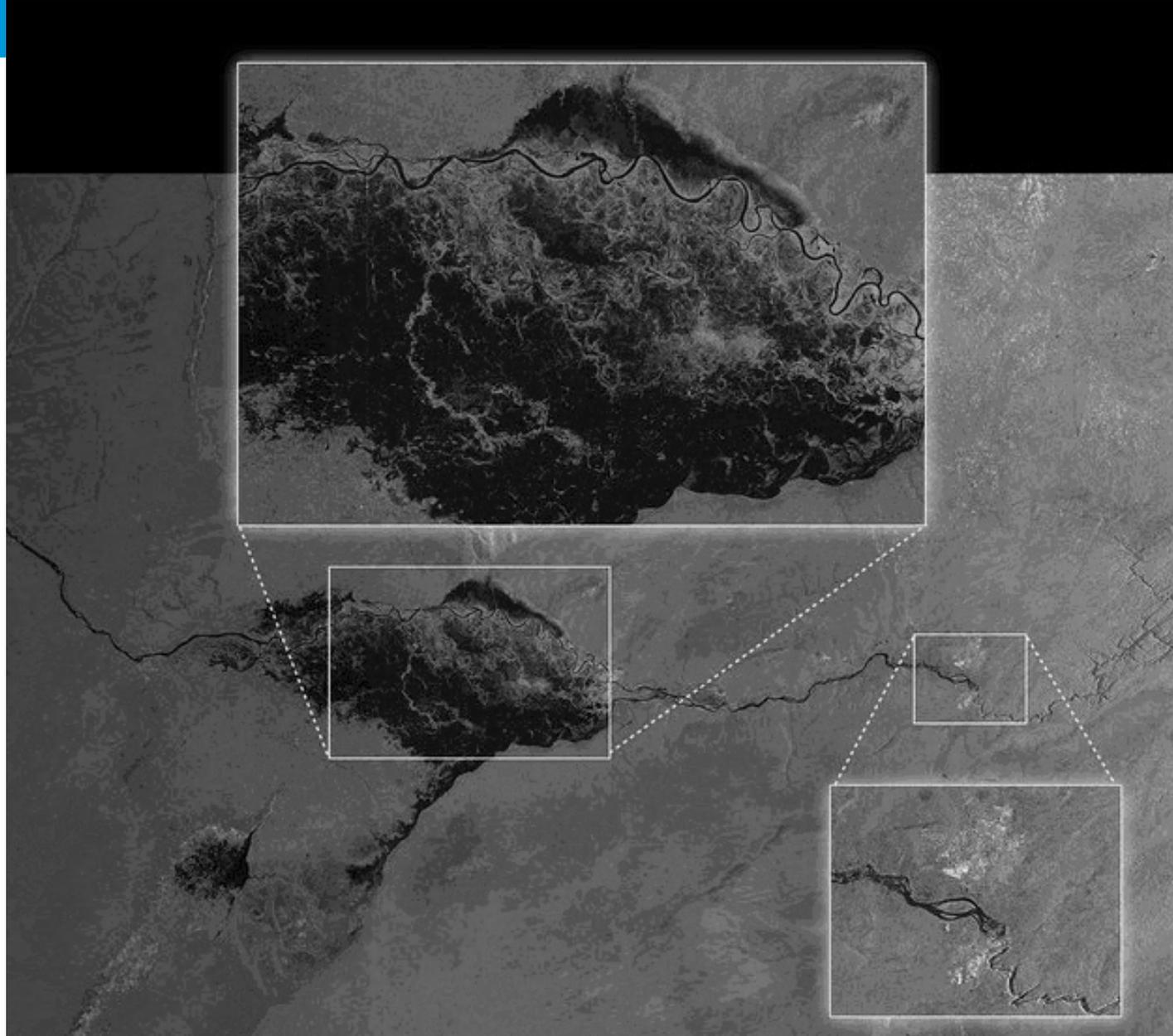
- 4 April: danger of a collision with a NASA satellite called ACRIMSAT (not manoeuvrable)
- Collision avoidance manoeuvre during LEOP never done before and not simulated
- Need to reach normal pointing mode before doing the manoeuvre
- Significant risk of collision confirmed (20 meters distance) in two possible occurrences on 5 April in the morning
- Decision to change orbit to Sentinel-1A with a 39 seconds long manoeuvre
- The sequence of commands was uplinked during pass 37 in Alaska/Svalbard/Kiruna on 5 of April at 04:33 UTC for execution at 05:14 UTC, outside visibility
- Following pass over Troll Ground Stations showed that satellite was in Orbit Control Mode and manoeuvre had been successful

Sentinel-1A First Images - 1

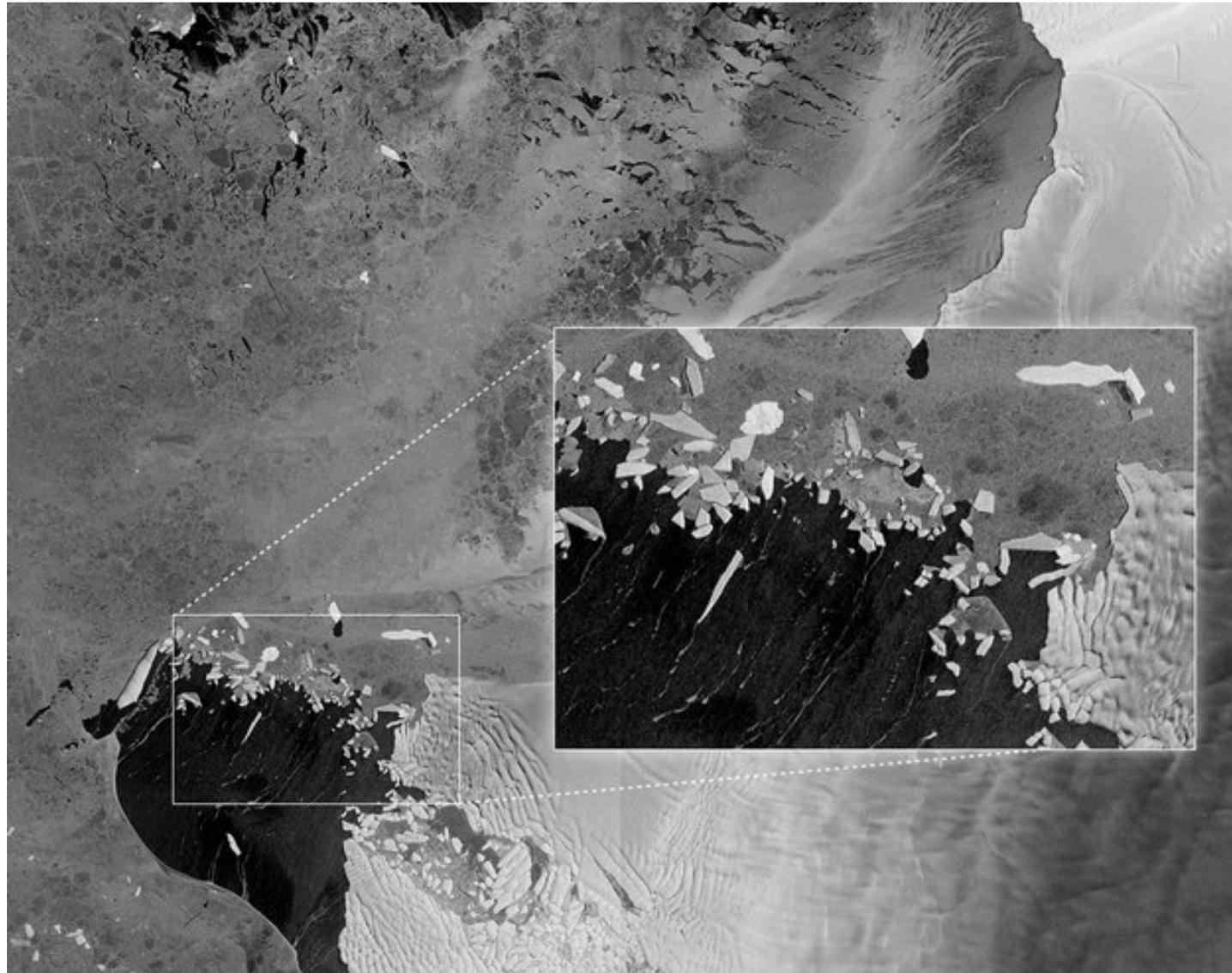
- **Captured on 12 April, just one day after the satellite was put into its operational attitude**
- **Demonstrates the potential of Sentinel-1A's radar vision**
- **Strip map' mode with a swath width of 80 km, resolution 5x5 m**



**Namibia
flooded by the
Zambezi river**



Pine Island Glacier in Antarctica. This glacier is in a state of 'irreversible retreat' so it is important to keep a very close eye on glaciers such as these as they lose ice to the ocean.



Sentinel-1A First Images - 4

**Transect over the
northern part of the
Antarctica Peninsula**



- Free, full and open data policy adopted for the Copernicus programme → access available to all users for the Sentinel data products, via a simple pre-registration.
- Following registration, users will have the possibility to download a test data set that simulates the data products that will be generated by Sentinel-1 and will be granted early access to Sentinel-1 data samples, even before the full operational qualification of the products is completed.
- On-line self-registration at: ***<https://senthub.esa.int/>***
- Technical information on Sentinel missions and users products can be found at: ***<https://sentinel.esa.int/>***

VIDEO AT

[http://www.esa.int/
spaceinvideos/Videos/
2014/01/Sentinel-1](http://www.esa.int/spaceinvideos/Videos/2014/01/Sentinel-1)

ESA EO DATA POLICY



FREE and OPEN DATASET:

→ For data collections available on-line
i.e. most of ESA EO data

- open and free of charge
- user registration done electronically

→ If datasets not (yet) available on-line,
i.e. mainly ESA SAR data:

- user project proposals received by ESA; data provided free of charge but with data quota limit due to processing capacities constraints



**Copernicus
information &
data policy
established by EU**



Third Party Missions → Data Policy of individual data providers

ESA Living Planet Symposium (Edinburgh, 9-13 September 2013)

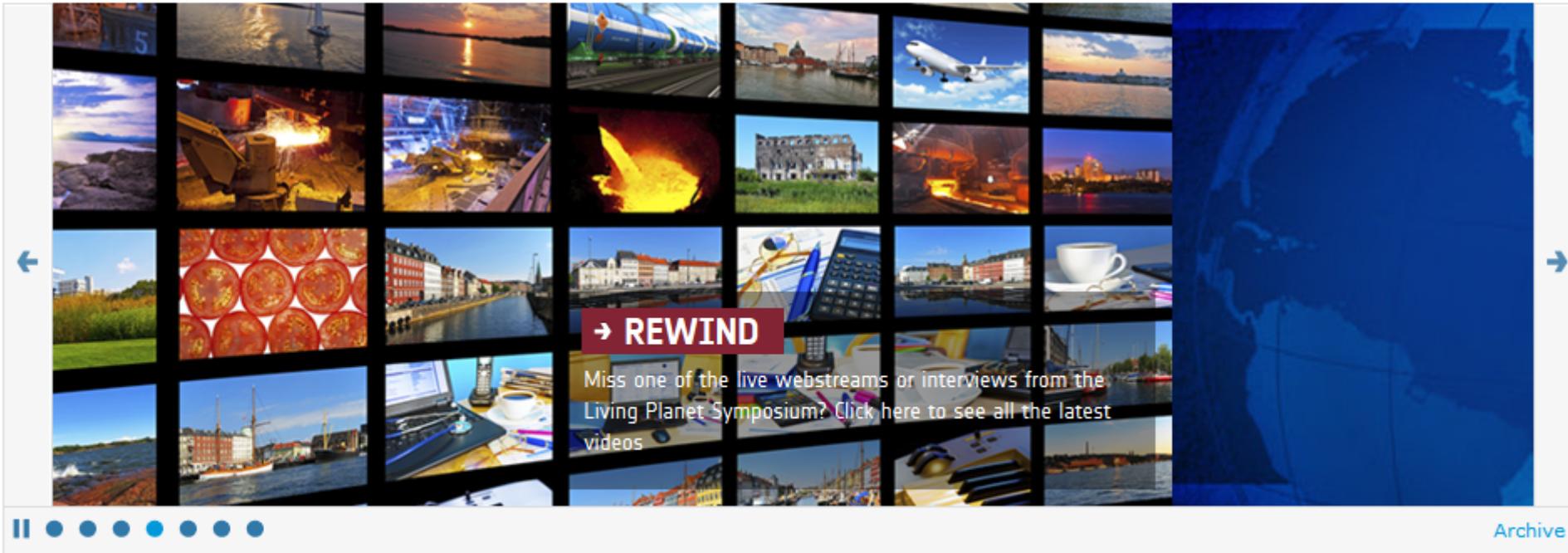


Few numbers:

- ✓ 1700 participants (all ages !)
- ✓ 200 high school students and teachers attending the School Lab
- ✓ 1750 abstracts
- ✓ 740 oral presentations and 920 posters
- ✓ 18 hours of web-streamed oral presentations
- ✓ ... and a lot of beers and whiskies



Programme and all info available at:
<http://www.livingplanet2013.org/index.asp>



→ **REWIND**

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